

that Eucalyptus seed had frequently been sold under fictitious names, the seeds of common and inferior kinds having been substituted for the more valuable descriptions.

Mr. Brazier exhibited a collection of sternums of Fowls displaying the effect of different kinds of perches in modifying the shape and curvature of the ridge. Mr. Brazier showed that where the fowls roosted on a round perch the breast bone was normal; but those that roosted on flat battens had the breast bone distorted.

Mr. Masters exhibited a *Majaqueus Parkinsoni* or New Zealand Petrel shot near Sydney Heads, and remarked that it was the first recorded instance of this bird visiting the Australian Coast.

MONDAY, MAY 27TH, 1878.

W. J. STEPHENS, ESQ., President, in the Chair.

MEMBERS ELECTED.

CHARLES JENKINS, ESQ., L.S., Yass, and T. TENISON-WOODS, ESQ., Sydney.

DONATIONS.

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PAPERS READ.

ON THE GEOLOGY OF YASS PLAINS.

By CHARLES JENKINS, ESQ., L.S., Yass.

Plate VI.

In offering an account of some years' labor in the fossiliferous strata around Yass, I must apologize for not giving at present all the detail that may be desired. I find it impossible to accompany this paper with the necessary plans and sections, the result of surveys I have made, without which minute description would be unsatisfactory. I hope, however, in a future paper to supply the information I am now compelled to omit, accompanied by drawings of as many of the principal fossils as possible.

It is chiefly of the beds exposed for three or four miles along the course of the Yass river after it reaches the town of Yass that I shall at present treat.

The Yass river enters the town of Yass on the east, then makes generally a westerly direction flowing alike over hard and soft rock, porphyry and shale, just as the dislocation of the strata had marked out for it a course, which it has deepened and widened as best it could.

Very interesting are the cliffs on each side. Now we have two hills of porphyry of very different composition, facing each other—the junction of the two porphyries being the bed of the river—then seventy feet of shale and limestone, every vertical foot of which will yield a rich harvest to the geologist. A little further and we have the section of a hill in which the strata broken off on each side are bent in towards the centre, making there almost as acute an angle as the letter V. Again, a little further, and the strata are reversed, vertical, then contorted in the most varied curves, and the former impure limestone changed into marble, marked with pink and other colored stains in patterns of the sections of the shells and corals it formerly contained.

The main course of the valleys on either side show a somewhat different origin to that of the river. They are formed chiefly by the scooping out of the softer strata, leaving ridges on each side capped by the more indestructible rock. As the direction of the dip of the strata is from 20° to 40° south of west, these ridges that flank the valleys present to view in many places as you turn east steep encarpments, and gentle slopes as you look west. They bend round the igneous rock to the west of Yass, forming part of a great curve, not, however, by an uniform sweep, but by jumps, wrenched aside with a sudden twist and interrupted by faults. These faults and twists have given rise to smaller valleys and water-courses, which, in general, mark the limit of the broken and intruded strata.

Wonderful things are those hard rocks that cap the Humewood and Belle Vale ridges. In one place we have an ancient Coral Reef, rich in the most varied Palæozoic forms,

and differing, I imagine, from the Coral Reefs now forming, only as Palæozoic differs from recent Coral. A little further, and if you are fortunate in cleaving the stone you will have a surface presenting a strange confusion, on which it will be difficult to find a spot not occupied by one of the fossil forms of the varied life of the old seas. Another will yield hardly anything but Trilobites, jammed together heads and tails so thickly as to render it difficult to procure a perfect specimen.

I will now go back to our former starting point, and take the Yass beds in the order of their deposition. Standing at the edge of the igneous rock (a kind of syenetic porphyry) where the river enters the town on the east side, and turning westward, you will look straight across the fossiliferous strata, which here, with intervening Porphyry and altered rock, have a breadth of from four to six miles. The view across the strata is interrupted by the range west of the town. The mass of this range is Porphyry. This Porphyry naturally divides the sedimentary rocks into two parts—that portion to the east of the Porphyry bending in one direction to the south-east over the Yass Plains, and in the other marked by the course of part of the Bango and Fairy-hole Creeks, I propose to call the *Yass Beds*. That portion to the west of the Porphyry, and bending to the south-east over the Yass Plains, and in the opposite direction, west of north, along a course marked by part of the Derringullen and Limestone creeks, to about a mile above the junction of these two creeks, I propose to call the *Hume Beds*—these beds being so largely developed on the property that belonged to the late Hamilton Hume, Esq., our great explorer.

Starting then on the edge of the Yass Beds, following the river, we have first a few feet of altered strata, a thin layer of limestone, then two feet of fossil bearing strata. Of species obtained hence there are four Brachiopods, including a small *Lingula* and an *Atrypa*; three Gasteropods, including one very like *Bellerophon acutus*; an impression of a rather large *Orthoceras*, and a number of very small things not made out.

Then follows some black, slaty-looking shale, cleaving readily in the direction of the bed. These beds gradually become more

micaceous and gritty, with an occasional thin band of limestone until they pass into hard compact grit, at a thickness of about 500 feet from the Porphyry. The upper and lower beds of grit are separated by strata of greenish shale; the lower grit is in some parts thin, flaggy, and easily disintegrated, in others compact and rudely jointed.

The lower portion of the grit is in some places full of cubical crystals of oxide of iron. Some of the upper grit has been quarried for building. It exhibits, in many places, distinct ripple marks. The top course is, however, very hard, siliceous, coarse-grained, and sometimes almost conglomerate, with signs of altered condition. I have obtained no fossils from the grit.

The top of this upper bed affords a convenient means of dividing the Yass Beds into two parts, giving to the lower portions a thickness of about 700 feet.

The next division, the especially fossil bearing half, is best studied by starting from the rock just described at a point where it crosses the river, about a quarter of a mile further down. The strata, after some thin, not very coherent, gritty beds, gradually become calcareous, until they pass into a compact flaggy limestone, just above the *Spirifer* Beds. The fossils found lowest in this division were a *Lingula* and a *Trochus*, succeeded occasionally by an *Orthonotus*, and some ribbed *Spirifers*, until at a thickness of about 135 feet we have a small band of black impure limestone, nine inches thick, loaded with fossils.

This band at first contains chiefly several species of *Murchisonia* and some of *Loxonema*, succeeded by a layer of *Spirifers*, and these by a thin mass of *Pterinea* and *Modiolopsis*. Among the *Spirifers* we find here, however, there is no *Spirifer Yassensis*. That *Spirifer* cannot be obtained nearer than the Devonian of the Murrumbidgee, in which strata, at a distance of about twelve miles from Yass, it abounds. A *Retzia*, *Orthis*, and *Orthoceras*, were also found here.

I will now pass over some flaggy limestone; two beds, from 3 to 4 feet thick, of compact sub-crystalline limestone, the latter though full of fossils, yielding little; and some Calcareous gritty beds, to an impure limestone, from which many species have been obtained.

The chief fossils obtained from this rock were several species of *Spirifer* and *Atrypa*, including *Atrypa reticularis*, and *A. aspera*—a *Strophomena* (dorsal valve *convex*), a *Bellerophon*, *Eunema*, *Ecculiomphalus*, *Maclurea*, and a large Helix-like *Trochus*. Among the Conchifers, a large Arca-like species is the most conspicuous. Of Trilobites; *Phacops*, and *Cromus*. This limestone, at Mylora, is overlaid by a flaggy unfossiliferous limestone. The whole thickness of the Yass Beds, near Yass, is about 1,000 feet. Dip from 30° to 40° lower division. Dip from 18° to 40° upper division.

We will now stop in our progress across the strata, and turn aside a little to the south. Near one of the lower limestone courses, beyond the town, I have obtained some very small fossils that help to connect together the different parts of the Yass Beds, and the Yass with the Hume Beds. A head of a small sized *Bronteus* was found here. Peculiar to this spot is a small, spherical, tuberculated *Glabella*, having a very Devonian aspect.

HUME BEDS.

Crossing now the Porphyry, separating the Yass and Hume Beds, and starting from where the latter cross the Yass River, and following the westward course of the river to a steep cliff, then continuing in nearly the same direction across the beds, we shall take the strata as before in the order in which they were laid down.

These beds are naturally divided into four parts, which division will answer our present purpose well enough. The first, from the Porphyry to the river at the base of the cliff, near the junction of Boonu Ponds with the Yass River; the second, from the river to the top of the Coral Reef; the third, from the Coral Reef to the Trilobite Limestone; in the fourth, I have not as yet found any fossils. We have first some laminated Porphyry, in which are various fossils, among others encrinital stems of a Lower Silurian type; then a limestone, more developed and richer in fossils, at the Derringullen and Limestone Creeks; then a mass of sub-crystalline altered rock, traversed in one place by igneous

rock; then a limestone, composed of thin courses of hard sub-crystalline nodules, weathering yellow, set in a blackish, less pure limestone; then alternations of shale and limestone to the river. From this portion I have obtained the following fossils:— Trilobites; *Cheirurus* (Pl. VI, figs. 5, 6 and 7); *Calymene* (Pl. VI, fig. 4); *Spherexochus* (Pl. VI, fig. 2); *Homalonotus*, *Acidaspis*, *Cromus*, and *Encrinurus*. Brachiopods; *Pentamerus*, including (especially to be remarked) *P. oblongus*, (Pl. VI, fig. 3), *Atrypa*, *Rhynchonella*, *Spirifera*, *Orthis*, *Lingula*, and *Discina*. Gasteropods; *Murchisonia*, *Euomphalus*, and *Bellerophon*. Conchifers; *Orthonotus*, *Modiolopsis*, and *Pterinea*.

The *Pentamerus oblongus* is confined to about the lower two thirds of this division. *Cheirurus* becomes rare in the upper part; *Calceola* is found all through. Especially remarkable is it that near the top of this division are two bands of limestone of from six to nine inches thick, containing fucoids. Crossing the river at the bottom of a steep cliff, we have thin courses of nodules and flags of limestone, often concretionary, alternating with shale, which frequently shews the same concretionary structure, gradually becoming more calcareous until it passes into an absolute Coral Reef.

The shale of this division is the richest of any in variety of species. The lower part especially abounds in *Pentameri*; *Atrypa* is scarcely less abundant; *Atrypa desquamata* especially plentiful. *Spirifera* and *Calceola* are equally characteristic of this zone. Some of the *Spirifers* have a very sub-carboniferous look and are like *Spirifer glaber*. *Orthis elegantula*, and *canaliculata*, and a large *Strophomena* are only found here. The *Strophomena*, like most of those in the Yass Beds, has the *Dorsal* valve convex in the manner of *Strophomena euglypha*. Cup corals are everywhere here. Of the wonders of the Coral Reef at the top of this cliff, what shall I say? I have not yet made out one tenth of the species. Among others there are, however, *Favosites Gothlandica*, *F. aspera*, and *Heliolites Interstinctus*; all Silurian species.

The next division is characterised especially by the Trilobites of the genera *Bronteus*, *Calymene*, and *Spherexochus*, together

with a large Trilobite closely allied if not identical with *Phacops longi caudatus* which occurs in the top beds. One *Calymene* is undoubtedly *Calymene duplicata*. The *Spherexochus* is almost identical with *Spherexochus mirus* as figured by Murchison.

Size of largest *Calymene* $2\frac{1}{4}$ inches in length.

Size of largest *Spherexochus* 2 inches in length.

The Trilobite in the upper bed (Pl. VI, fig. 1), which is an impure limestone, is chiefly associated with a *Petraia*. Some parts of this limestone literally swarm with segments of this Trilobite. I have, however, obtained one cast, rather mutilated, of the whole body, and another whole Trilobite doubled up. The head segment of this Trilobite is very like that of *Dalmania pleuroptyx* as figured by Dana, both in its general proportions and the direction of the facial suture; the furrows on the Glabella are straighter in Dana's figure than on any specimen I have. *D. pleuroptyx* is a Silurian species, though, like *Phacops*, *Dalmania* is both a Devonian and Silurian genus.

These Trilobites attained a size of 5 inches in length exclusive of the spinose caudal appendage.

As I have obtained no fossils in the next division and as after attaining a thickness altogether of 2,000 feet these beds by folds and faults repeat themselves until they reach the Igneous Rocks, I shall not at present trace them farther.

In comparing the results obtained from the Yass and Hume beds, I think that there is sufficient evidence in the similarity of the fossils to shew that they must both be classed in one formation.

I cannot speak of the exact number common to both, but there are certainly among the Brachiopods—two species of *Atrypa*, including *Atrypa reticularis*—several of the genus *Spirifera*, including two plaited Spirifers, two of *Strophomena*, and one of *Retzia*. Of Couchifers I believe several, including an *Orthonotus* and a *Pterinea*; a *Murchisonia* among the Gasteropods; of the Trilobites *Bronteus* and *Cromus*. There is no doubt about the *Cromus*; the *Bronteus* is, however, in the Yass beds so small, and the markings so indistinct, that it is not possible to speak with certainty, but what can be seen makes it probable that it is identical with that found in the Hume beds.

In contrasting these beds lithologically, the large proportion of grit dividing the Yass beds into such unequal halves, and the absence of those large limestone masses which form so prominent a feature in the Hume beds, are the first things to attract attention. Then we have in the Hume beds an almost entire absence of that somewhat symmetrically transverse jointed structure exhibited in most of the Yass grit and limestone, and instead, a preponderance of concretionary structure in limestone and shale.

Then as to the fossils—the absence in the Yass beds of large corals generally, and especially of those masses which are so remarkable in the Hume beds is also to be observed. The fossils of the Hume beds are further distinguished by the number of individuals, large size and variety of species and genera of Trilobites, the number and variety of *Pentameri*, and by the presence especially of *Pentamerus oblongus*; by the number and variety of the genus *Orthis*, and by two layers of limestone containing *Fucoids*; also by their being distributed with an approach to uniformity through a great thickness of strata, whereas in the Yass beds all the fossils are collected in bands which, if taken altogether, would not be more than from 10 to 20 feet thick.

The character imparted to fossils of the Yass beds is due to the great number and variety of plaited Spirifers, and the number of *Murchisonia*, *Bellerophon* and *Pterinea*. Peculiar to these beds is also a *Maclurea*, a large Helix-like *Trochus*, an *Ecculiomphalus*, and a small Trilobite, with a nearly globular glabella covered with tubercles.

These differences of the fossils of the two series of beds cannot however, as I think, be considered as altogether marking the characteristics of the different geological periods. The local conditions under which these deposits have been formed have undoubtedly done much to produce the results we now see. When the Yass beds were being laid down, there must have been at least four principal changes of level, two of elevation and two of depression, as evidenced by the double series of bands of grit beds, separated by intervening shale. The waters were tolerably troubled too during the deposition of some of these beds, for some

of the upper limestone is full of lumps of shale. These considerations may account for the absence of the larger corals, and together with the fact that many recent species of *Trochus*, *Avicula* and *Cephalopoda* are found between low water and 50 fathoms may explain why the first remains of the fauna of the seas that succeeded the sinking of the old shore—now represented by the grit with its ripple marks—should be such a group as we there find of *Modiolopsis*, *Avicula*, *Murchisonia*, and *Orthoceras*. That the sinking was interrupted by periods of upheaval, seems probable from the thin layer of sandstone covered with *Aviculidæ* that occurs above the strata of Spirifers and *Pterinea*. This thin layer seems to explain a rather notable thing connected with this Spirifer bed. Evidently, to my mind, these Spirifers were not buried in the order their fossil shells now lie. From a foot below the Spirifers to this sandstone layer everything appears sorted. First we have a layer of irregular lumps, then one of smaller lumps, often containing a *Murchisonia*, a *Loxonema*, and an occasional Spirifer; then a layer of almost nothing but Spirifers as close together as possible, but scarcely an inch thick; then *Pterinea* two or three deep, but not making a thickness of half an inch; then smaller *Aviculidæ* and sandstone. Does it not seem probable that the temporary rising of the sea bed brought the burial place of these mollusca within the action of the tide, whose ebbing and flowing has sorted them in a manner that no other agent but running water, as far as I know, ever does.

NOW AS TO THE AGE.

It cannot be expected to establish in Australian geology the minute subdivisions it has been found necessary to make in the geology of other distant countries; very unlikely, for instance, that the same breaks should occur here as in England and America. The division of upper and lower Silurian not arising from local arrangements has been made out in all countries where the Silurian system is at all developed. I therefore consider the terms upper and lower Silurian can be used here. The Yass Period, or the period of the deposition of the Yass and Hume

beds, I believe to be essentially upper Silurian, and one portion at least to represent the equivalent to the lower part of the upper Silurian of other countries.

No fish bones have yet been discovered, so that at present the Yass Period satisfies the requirements of the Silurian formula: a *Fauna* represented by invertebrates, of which the *Articulata* are chiefly Trilobites; and a *Flora* by *Fucoids*. To the Trilobites, however, we must look for the most decisive testimony. The fact of *Calymene* ranging all through the fossiliferous portion of the Hume beds, and *Cheirurus* and *Spherexochus* ranging nearly through—these being exclusively Silurian genera, is almost sufficient evidence in itself from which to class these beds as not newer than the upper Silurian; while the absence of any Trilobites of exclusively lower Silurian genera affords a presumption that they are not older, which presumption is strengthened by the presence of *O. reticularis* and *Pentameri*. The presence of the large Trilobite closely allied, if not identical with *Phacops caudatus* and having no resemblance to the Devonian species of *Phacops*—and of the *Homalonotus* which is not of the characteristic Devonian type, all add force to the evidence afforded by the frequent occurrence of the other Trilobites. The only part of a Trilobite with a Devonian aspect I have found in the Yass beds is the Globular Glabella. The variety of *Orthidæ*, of Silurian species, as *Orthis elegantula*, helps to stamp these beds Silurian. While the abundance of *Pentameri*, especially the presence of *Pentamerus oblongus*, support the inference that part of these beds may rightly be considered to represent the lower part of the upper Silurian. The presence of a *Maclurea* must not be forgotten.

Pentamerus oblongus is especially relied upon by Sir Roderick Murchison as determining the strata in which it occurs, in Europe and America, to be the equivalent of the *Llandoverly* of the British Siluria. The *Cheirurus* found in these beds is *Cheirurus insignis*, a *Llandoverly* species. (Recherches, sur les fossiles, Paleozoïques de la Nouvelle Galle De Sud, par L. C. De Koninck). †

† The following is a list of fossils, which, in Professor Koninck's work already quoted, are classed as Devonian, and said to be found in the

Among the corals we have unquestionable Silurian species, *Favosites Gothlandica*, *F. asper*, *Heliolites interstinctus*.

The occurrence of hollow encrinital stems, a lower Silurian type, gives additional weight to evidence in favour of one portion at least being the equivalent of the lower portion of the upper Silurian.

The presence of *Calceola* and *Atrypa desquamata* cannot be considered to outweigh the evidence drawn from the mass of Silurian species among which they are found. Their presence there is not so remarkable as was the finding, in Bohemia, in the midst of Silurian species, of large-sized *Goniatites*, supposed before to be no older than Devonian.

To these reasons I will add, that in the limestone of the Murrumbidgee, which in places is crowded with many plaited broad winged Spirifers, I have found *Spirifer Yassensis*, *Leptaena subaequicostata*, *Loxonema anglicum*, *Niso Darwinii*, species determined by Professor Koninck from specimens forwarded to him by the Rev. W. B. Clarke, to be established Devonian fossils; but I have not found a sign of a trilobite nor one shell common to both the Murrumbidgee limestone, and to the Yass and Hume beds. I will not conclude without some reference to the igneous rocks. They are all chiefly Porphyry, some very like Syenite, and presenting on the hill tops a very granitic arrangement of boulders. Other varieties are numerous, some with a pink felspathic base, and several with rather large crystals of felspar

neighbourhood of Yass, but which are certainly not to be found in the Yass or Hume beds. They will all, I have no doubt, be found where I found those marked with an asterisk (*), that is on the Murrumbidgee, in beds overlying unconformably the Yass and Hume series.

Discina Alleghania
Chonetes Hardrensis
Leptaena nobilis
Rhynchonella Pleurodon
Spirifer multiplicatus
Spirifer Cabedensis
Spirifer Lalisinuatus
Mitchella Striatula
Nutica Cirriformis
Cystoceras Woodsii

Orthoceras subdiminuatum
Murchisonia Turris
Murchisonia Vernuliana
Murchisonia Granifera
Bellerophon convolutus
Pleurotomaria Subconica
 * *Leptaena Subaequicostata*
 * *Spirifer Yassensis*
 * *Loxonema anglicum*
 * *Niso Darwinii*.

and Hornblende, and probably Pyroxene. That some of these rocks are newer than the sedimentary beds is evident by the altered conditions of some of the strata in contact with them.

Some may be of the same age, for in several places we have the Porphyry enveloping fossils, while in others it is studded with casts, which it has beautifully preserved, while it has destroyed the shells.

Of metals I will merely mention the fact that Galena has been obtained in the Hume beds at Limestone Creek, near its junction with the Derringullen, and near the Derringullen Creek, about three miles from its junction with the Yass River.

In comparing the fossils of these beds with those of the upper Silurian of other countries, the absence of Graptolites is a marked peculiarity. There are, however, abundance of Bryozoan and probably Sertularian forms. It will also be noticed that there are wanting those large forms of Cephalopoda which are usually found in some of the beds of that age.

This last fact seems of itself to point out how small a portion the Yass Period represents of the Silurian of New South Wales, and how impossible it would be to attempt to fix the exact position of these beds in the Silurian series, until other beds of the like age have been examined as carefully as these have been.

EXPLANATION OF PLATE VI.

- No. 1.—*Phacops* from the Limestone (Belle Vale Limestone),
upper bed of 3 division Hume bed.
- „ 2.—*Sprenochus* from the Hume beds.
- „ 3.—*Pentamerus oblongus*. Hume beds, lower portion.
- „ 4.—*Calymene Duplicata*. Hume beds. (Lower Silurian,
Europe).
- „ 5 to 6.—*Cheirurus*. Hume Beds.
- „ 7.—*Cheirurus Insignis*. Hume Beds.
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